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MODERN MIGRATION of Prehistoric Beasts

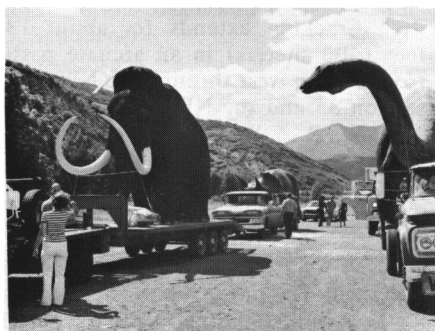


Photo from the Division of Parks and Recreation.

Traffic was delayed when life-sized models of dinosaurs and mastodons were moved from their original home in southern Utah. The beasts were purchased by the state of Utah for display in the Dinosaur Garden at Vernal in the Natural History Museum State Park, Division of Parks and Recreation.

The models of the beasts were made by Elbert Porter, who has taught sculpture at the University of Utah. He was originally inspired by the dinosaur remains at Vernal, Utah. Some friends formed a corporation to finance the building of the dinosaurs, but the corporation folded and Elbert was left with a flock of dinosaurs and no place to put them. He first took them to West Yellowstone; after 6 years he moved them to the less rigorous climate at Orderville, Utah, where his dinosaur park was a family affair. As his family grew up and left home, he and his wife decided to accept the State's offer to buy the dinosaurs, and once again the migration set off, this time to a final home at the Dinosaur Garden at Vernal.

Elbert Porter and his wife toured museums all over the country to find the best way to make the dinosaurs. The full-scale models are first built of plaster of paris, then cast in fiberglass.

Research Tower Aids Lake Studies

Approximately two years ago, the UGMS installed its research tower No. 1 in the Great Salt Lake (see Survey Notes, May 1976, page 7) to provide a platform for a number of hydrological and meteorological instruments and as a stable base from which lake-related research can be performed.

As with any new venture, the research tower and its related instrumentation have not been without problems. In fact, the lake, with its extremely corrosive and unstable environment, provides an excellent test of the design of a structure or of the internal workings of various types of electrical and mechanical instrumentation.

The tower has provided UGMS researchers with much valuable data from the instrumentation. Various tests conducted from the tower owe their high degree of success to its relative stability. Nearly continuous records have been obtained from the anemometer, water temperature recorder and the meteorograph, which records air temperature, humidity and barometric pressure. Using the tower as a stable base, researchers have, for the first time, been able to take samples from the surface down to the bottom of the lake in precisely measured increments.

Access to the tower is by boat from the Silver Sands Marina on the south shore of the lake. During periodic servicing, the data printout tapes and chart papers are changed and the power supply, a bank of 12 volt storage batteries, is replaced.

Within the past few months Amoco Production Company has installed two similar towers in the lake, one near the north end of the south arm of the lake and the other near the south end of the north arm of the lake. The Amoco towers will provide lake wind, wave, and current

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HILLSIDE TERRAIN DEVELOPMENT WORKSHOP

On Friday, November 18, 1977 more than 100 Utah professionals attended a workshop devoted to the problems of urban development on hillsides, hosted by the Hilton Hotel. The workshop was sponsored jointly by the Utah Chapter of the American Institute of Planners and the Utah Geological and Mineral Survey. The program was arranged by William C. Ligety, Salt Lake City Planner; Bruce N. Kaliser, UGMS Engineering Geologist; Joseph Moore, Planning Director of Davis County; and Robert Scott, Davis County Planner.

The topic of hillside problems in Utah was introduced by a lunch-time viewing of the videotape "Cliff Dwellers" provided by Ed Yeates of KSL TV. Then the two principal speakers outlined the California experience in hillside development, one from the point of view of the engineer and the other from that of the planner. The remainder of the afternoon was devoted to discussion by a panel of Utah professionals and to an exchange of views between panel, audience, and speakers.

Beach Leighton of Leighton and Associates, Irvine, California, discussed the engineering approach to hillside development, beginning with an outline of the common problems faced in California: hillside instability, whether old landslides or new instabilities generated by improper grading, seismic hazard, drainage problems, and other foundation problems such as expansive soil or old land fills. His remarks concluded with a discussion of the presently accepted engineering solution to these problems (all of them expensive) and a discussion of the current techniques used by engineering geologists to evaluate building sites in California.

John Prescott, Planner for the City of Thousand Oaks, outlined the experience of Thousand Oaks, a relatively new

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U.S. Geological Survey

Open File Reports

Unpublished reports by the U.S. Geological Survey that describe the geology of Utah are kept on open-file at the Utah Geological and Mineral Survey, 606 Black Hawk Way, Salt Lake City. Because UGMS has only one copy of each report, they must be inspected at its offices and cannot be taken out. Copies of these reports may also be inspected at the USGS Public Inquiries Office, Federal Building, 125 South State Street, Salt Lake City, and may be ordered from: Open-File Services Section, Branch of Distribution, U.S. Geological Survey, Box 25425, Denver Federal Center, Denver, Colorado 80225

Reports received at UGMS since our last listing in the August SURVEY NOTES are:

76-153. Measurement of "Turbidity" and Related Characteristics of Natural Waters, by R.J. Pickering, 1976.

76-577. Organic Carbon and Selected Element Distribution in the Phosphatic Shale Members of the Permian Phosphoria Formation, Eastern Idaho and Parts of Adjacent States, by E.K. Maughn, 1976.

76-729. Geochemical Survey of the Western Energy Regions (formerly Geochemical Survey of the Western Coal Regions), Third Annual Progress Report, July 1976, by U.S. Geological Survey, Denver, Colorado 1976.

77-120. Hydrology and Surface Morphology of the Bonneville Salt Flats and Pilot Valley Playa, Utah, by G.C. Lines, 1977.

77-470. The Biostratigraphy and Paleoecology of the Gerster Limestone (Upper Permian) in Nevada and Utah, by B.R. Wardlaw, 1977.

77-509. Preliminary Chart Showing Description of Rock Types, Lithologic Groups, and Depositional Environments for Some Early Tertiary and Late Cretaceous Rocks from Outcrops at Willow Creek-Indian Canyon through the Subsurface of Duchesne and Altamont Oil Fields, Southwest to North-Central Parts of the Uinta Basin, Utah, by T.D. Fouch, 1977.

77-548. Leasable Mineral and Waterpower Land Classification Map of the Salina Quadrangle, Utah, By J.E. Smedley, E.M. Pera, and G.A. Lutz, 1977

77-567. Well-Sample and Core Repositories of the United States and Canada, by C.K. Fisher and M.P. Krupa, 1977.

77-602 Leasable Mineral and Waterpower Land Classification Map of the Tooele Quadrangle, Utah, by E.M. Pera, J.E. Smedley, and N.L. Curtis, 1977.

77-603 Leasable Mineral and Waterpower Land Classification Map of the Cortez Quadrangle, Colorado-Utah, by E.M. Pera, E.G. Allen, and G.A. Lutz, 1977.

77-604 Leasable Mineral and Waterpower Land Classification Map of the Ogden Quadrangle, Utah-Wyoming, by E.G. Allen, E.M. Pera, J.E. Smedley, and G.A. Lutz, 1977.

77-606 Helium Sniffer Field Test: Roosevelt Hot Springs, Utah, October 1975 and March 1976, by E.H. Denton, 1977.

77-612 Leasable Mineral and Waterpower Land Classification Map of the Moab Quadrangle, Utah-Colorado, by D.A. Decicco, E.M. Pera, E.G. Allen and G.A. Lutz, 1977.

77-627 Leasable Mineral and Waterpower Land Classification Map of the Delta Quadrangle, Utah, by E.M. Pera, J.E. Smedley, and W.F. Burns, 1977.

77-637 Oil-Shale Resource Investigations of the U.S. Geological Survey, by J.R. Donnell, 1977.

77-761 Subsurface Geology of a Potential Waste Emplacement Site, Salt Valley Anticline, Grand County, Utah, by R.J. Hite, 1977.

77-822 Preliminary Geologic Map of the Emery West Quadrangle, Emery and Sevier Counties, Utah, by P.T. Hayes and J.D. Sanchez, 1977.

77-823 Preliminary Geologic Map of the Flagstaff Peak Quadrangle, Emery, Sanpete, and Sevier Counties, Utah, by J.D. Sanchez and P.T. Hayes, 1977.

77-833 Descriptions of Stratigraphic Sections, Upper Cretaceous Blackhawk Formation and Star Point Sandstone in the Emery West and Flagstaff Peak Quadrangles, Utah, by W.E. Marley III and R.M. Flores, 1977.

78-114. Mineral Potential of Altered Rocks near Blawn Mountain, Wah Wah Range, Utah, by D.A. Lindsey and L.M. Osmonson, 1978.

At Moon Lake Earthquakes, Ground Cracks

Major ground cracking resulted from the two earthquakes which shook the northwest Uinta Basin last September 30 and October 11 (Survey Notes, November 1977). The cracks were noticed by cowboys rounding up cattle on the Fisher Ranch about 3.8 miles (7.1 kilometers) southeast of Moon Lake, Duchesne County.

Cracking extends for about 1300 feet (400 meters) in an arcuate pattern from east to west through the NW¼ NW¼ section 35 and the NE¼ NE¼ section 34, T. 2 N., R. 5 W.. The zone is from one foot (30 cms) to 15 to 18 feet (4.5 to 5.5 meters) wide and involves one to 5 cracks. Displacement across the zone is from one inch (2.5 cms) to 18 inches (45 cms), down to the south. The largest displacement is on the eastern end of the zone across multiple, closely parallel cracks. Individual cracks are from one inch (2.5 cms) to 15 inches (38 cms) wide and the larger ones are estimated to stand open to depths of 50 to 100 feet (15 to 30 meters).



The zone of cracking cuts across a rocky alluvial fan which slopes south into Lake Fork valley. Along the trace of the cracks the ground shows much evidence (continued on page 5)



DIGGIN'S



GSA MEETING AT BYU

The Department of Geology at Brigham Young University in Provo, Utah, will host the 31st Annual Meeting of the Rocky Mountain Section of the Geological Society of America and the 12th Annual Meeting of the Pander Society on April 28 and 29, 1978.

Symposia will be held on: (1) The Stratigraphy and Sedimentation of the Basin and Range (D. Clark). This symposium will be held in honor of the retirement of Dr. Harold J. Bissell. (2) Conodont Biostratigraphy of the Rocky Mountain and Basin and Range provinces (C. Sandberg).

SAILS IN THE SUNSET.

After 15 years of operation the Great Salt Lake "Navy" is no longer under aegis of UGMS. The *G. K. Gilbert* and its smaller, faster companion craft (never officially named) have been transferred to the Division of Parks and Recreation and will join the DPR patrol and search and rescue craft on the lake. UGMS will call on its sister division in the Department of Natural Resources when boats are needed for sampling and research purposes and for servicing the instrument towers on the lake.

SO GOES THE NEIGHBORHOOD

Down the street to the south of the UGMS offices, earth moving machinery reshaping the land signalled the start of construction of the new multi-million dollar U.S. Bureau of Mines Research Center. Activity halted as wet weather made the ground unworkable, but construction is slated to begin as early as possible in the spring.

3rd TECTONIC CONFERENCE TO MEET AT DURANGO

The 3rd International Conference on Basement Tectonics will be held at Fort Lewis College, Durango, Colorado, on May 15-19, 1978. The conference is co-sponsored by the U.S. Geological Survey and the National Aeronautical and Space Agency (NASA). Speakers from many parts of the world will discuss deep fractures of the earth and related geologic problems.

FOR THE HANDICAPPED

Escalante Petrified Forest State Reserve is making petrified wood examples accessible to the physically handicapped in the campground area near Widehollow Reservoir. A 21-foot fossil log will be set into its natural alignment near a sidewalk so those confined to a wheelchair or those unable to hike will have the opportunity to see and feel petrified wood. A permanent plaque will explain the origin of the petrified wood.

COAL TO CALIFORNIA

Pacific Gas and Electric Company announced plans to build a coal-fired power plant in California. The coal will come from 150-million ton low-sulfur coal reserves owned by PG&E near Price, Utah. The coal will be brought to the new power plant by rail. *from Coal News*, December 30, 1977.

REFINING OIL USES ENERGY, TOO

Among major consumers of energy, the petroleum refining industry ranks with the primary metals, paper, and other energy consuming industrial activities. Why should a fuel producer be at the same time a fuel consumer? The refining of crude oil to produce its various products requires heat, and the heat is produced by burning fuel. Approximately 10 percent of the energy in the crude oil is consumed in processing.

INDUSTRIAL USE HOLDS NATURAL GAS PRICES DOWN

Would natural gas prices go down if industrial users were forced to stop using natural gas? A study prepared for the Natural Gas Supply Committee by Dr. Edward Erickson indicates that in Utah, in 1976, the average rate paid for natural gas by residential and commercial users was \$1.33 per million cubic feet or an annual average cost of \$257.42 per user. If all industrial use were stopped, the cost would become \$1.63, or an annual average cost of \$315.77 per user. Because the natural gas distribution system is used much more efficiently when there is a greater volume of gas, the cost of the natural gas to the residential and commercial user is actually decreased.

OIL FINDERS MEET

The Rocky Mountain Section of the American Association of Petroleum Geologists (AAPG) and its affiliate, the Society of Economic Paleontologists and Mineralogists (SEPM) will meet in Salt Lake City, March 19-22 at the Hotel Utah. A full program of technical papers including symposia on carbonate diagenesis and the Basin and Range will begin Monday, March 20. Regional and local field trips will be held March 18-19 and 22. Three continuing education courses sponsored by AAPG will also be conducted: Sandstone Diagenesis, Sunday March 19 and Cretaceous Coal Deposits and Exploration in Continental Rift Areas, Wednesday, March 22.

More than 1,000 geologists are expected to attend from the Rocky Mountain region and elsewhere in the U.S. and abroad. General chairman of the event are Stan Bardsley, consultant, and Ed Keller, Mountain Fuel Supply. Howard Ritzma, UGMS Assistant Director, is president of RMS/AAPG for 1977-78. The Utah Geological Association is official host organization.

Book Reviews

NEW AAPG PUBLICATION

Fracture-Controlled Production (Reprint Series No. 21) compiled by John R. Kostura and John H. Ravenscroft (13 papers, 221 pages). This volume was compiled from past AAPG Bulletin articles, and papers from AAPG Memoirs 16 and 18, dealing with natural fractures in reservoir rocks and the geology and technology needed for resource development. Price of the book is US\$6.00 (\$5.00 to AAPG and SEPM members)

COMPLETE INFORMATION ON URANIUM EXPLORATION

Applied Mineral Exploration with Special Reference to Uranium by Robert V. Bailey and Milton O. Childers, from Westview Press, 5500 Central Avenue, Boulder, Colorado 80301. Covers every aspect of uranium exploration from preliminary prospecting to advanced exploration, land acquisition, development of the property, with sections on mining law, leasing, promotion, and selling. Price is \$65.00.

Water Use in U.S. Doubles

Water use in the United States is up 110% since 1950, when estimates were first made by the USGS, but the rate of increase appears to be slowing. An average of more than 420 billion gallons per day is used for domestic, commercial, industrial, irrigation, and rural use. Of this, about 72% is available for reuse.

The greatest use is by industry, which uses an average of 240 billion gallons per day. Irrigation ranks second, with an average of 141 billion gallons per day, of which 80 billion gallons per day is unavailable for reuse.

In 1975, Utah used an average of 4090 million gallons per day. As a whole, the United States has ample supplies of water for the foreseeable future, but some areas face serious regional water shortages as demand exceeds available supply. *From Department of Interior USGS News Release 11-4-77.*

Origin of Desert Varnish

Caltech Mineralogist George Rossman and graduate student Russell Potter believe they have figured out the origin of the varnish that builds up slowly on rock formations in the West. Desert varnish is a smooth black coating found on formations that include small boulders, basalt flows, and cliffs hundreds of feet high. The underside of a varnished rock often acquires a glossy red-orange finish by interaction with water and minerals in the soil. Mineralogists have assumed that the varnish was composed mainly of manganese and iron oxides precipitated from inside the rock through weathering processes.

The Caltech scientists, using infrared spectroscopy, found, surprisingly, that the varnish comprises about 70% clay and only 30% iron and manganese oxides. The red coating on the underside of varnished rocks once thought to be mainly iron oxide is about 90% clay with an iron oxide stain.

Rossman and Potter deduce that desert varnish begins to form when wind-borne fine clay deposits on rock. Water moves through the resulting film, carrying with it traces of iron and manganese oxides that deposit when the water evaporates. The oxides form a structure that protects the clay from erosion, while depending on the clay for transport and deposition.

Ancient residents of the area created petroglyphs—symbolic pictures—by chiseling through desert varnish to expose the tan or light gray stone beneath.

Weather or Not

Now an absolutely foolproof weather-forecasting tool has been discovered; and when used in the right humor, it is bound to be a boon to sportsmen everywhere.

Known as the weather rock, the device is ingenious in its simplicity. A round and very smooth rock is hung from a rope just a few inches off the ground. Then a circle is drawn around the rock; and, with the aid of a compass, stakes are driven and marked to represent north, south, east and west.

But the key to the weather rock's success is its prognostication formula. It reads: (1) If the rock is wet, it may be raining; (2) if the rock is hot and dry, the sun may be shining; (3) if the rock is warm and dry, the sun did shine; (4) if the rock is damp and cold, it's probably cold; (6) if the rock is swinging toward a point rock, the wind may be blowing in that direction; (7) if the rock is swinging at a 45 degree angle, there is a good possibility of a tornado; if the rock is gone, you'd better go too.

There has been some reluctance on the part of certain experts to give their endorsement to the device until further field tests results are in; but for the moment, the only alternative that is anywhere near as accurate is a look out the window. *from Department of Wildlife Resources.*

Power Plant Site

The site of the Moon Lake Electric Association coal fired power plant near Bonanza was inspected recently by Jim Rogers, UGMS engineering geologist. Several sites are under consideration from Rangely, Colorado to Ouray, Utah, but the most likely appears to be Bonanza. Coal would be brought from mines northeast of Rangely by slurry pipeline to the plant site which is near the proposed White River Reservoir. The reservoir proposed by the State of Utah would provide 20,000 acre feet of water annually for the plant and for oil shale development in the area.

The plant would be built in modules (about 330 megawatts each) to a total of 1,000 megawatts. Power generat-

ed would be used for oil shale development and other commercial and domestic uses in eastern Utah and adjacent Colorado. Power would also be generated by the White River Dam.

In addition to the main plant site (and 11 others), Rogers also toured the dam site and oil shale lease tracts in the vicinity. Jock Campbell, UGMS petroleum geology section chief, will assess the oil shale and oil and gas aspects of the plant site.

Bonneville Salt Flats - a Crusty Problem

In recent years, racing enthusiasts have claimed that the Bonneville salt crust - the surface of the world-famous Bonneville Speedway - has deteriorated. Because brines are withdrawn from a shallow aquifer on the Salt Flats for the production of potash, there was also a need for a factual evaluation of the area from which the withdrawals are made.

A 2-year study was initiated by the U.S. Geological Survey in cooperation with the U.S. Bureau of Land Management to understand effects of both climatic factors and man's activities on the Bonneville salt crust. The results of the study are given in a report, "Hydrology and surface morphology of the Bonneville Salt Flats and Pilot Valley playa, Utah," by G.C. Lines of the Geological Survey.

It was found that any deterioration of the salt crust of the Bonneville Speedway and surrounding area was related mainly to climatic factors, withdrawals of brine for potash production, and changes in surface drainage because of the construction of Interstate Highway 80. It was also found that minerals of the Salt Flats are moved across the area by wind-driven floods of surface brine and by subsurface flow of brine through a shallow aquifer.

The study found no remedial actions that would completely eliminate the conflict between users or transform the Salt Flats to its original state.

Findings in the report were based on measurements at approximately 150 observation wells, tests on the shallow aquifer, chemical analyses of the brine, and study of changes that occurred on both the Bonneville and Pilot Valley salt crusts. Data collected in the area of the unused salt crust in Pilot Valley were used as controls in separating natural changes and those changes caused by man's activities on the Bonneville Salt Flats.

Oil Shale Landmark

1977 will go down in history in Utah as the year of the first production of oil from oil shale. Operations by Geokinetics, Inc., Concord, California on a State of Utah lease in Uintah County began in the Spring of 1977 and has continued on a regular basis through December 1977 and into 1978. Production to the end of 1977 was 1,800 barrels of crude shale oil of which 1,300 were sold. The State of Utah will be paid about \$1,800 in royalties for 1977.

The Geokinetics operation uses the "fluff and puff" process in which thin but rich oil shale beds at shallow depth are fluffed up by conventional explosive charges set off in shallow drill holes, and then ignited. The oil shale is retorted by the heat produced, crude shale oil flows by gravity to the lower end of the pattern of explosive holes, and a small pump lifts the oil a few tens of feet to the surface.

The process is a true *in situ* process - modest for a start, but one with great promise.

More Dikes in the Uintas

Another igneous dike has been located in the eastern Uintas according to information received from Wallace R. Hansen, USGS, Denver. This dike occurs in the depths of Lodore Canyon along the Green River in northwest Colorado. Reports of additional dikes will be welcomed from fishermen, backpackers, hikers, birdwatchers - and wandering geologists.

New Name for New Dam

The earth-fill dam embankment now under construction on Big Brush Creek, 10 miles northeast of Vernal, Utah, has a new name. Originally called Tyzack, it has been renamed Red Fleet for the adjacent series of angular buttes composed of dark red Moenkopi formation topped by rust red Navajo sandstone. Because the three formations dip downward sharply to the south, the most interesting view of them is from the north where the sharp rocks seem to soar outward almost like a fleet of huge red boats under full sail up the face of the Uinta Mountains. When the reservoir is filled, the buttes will border the north shore of the lake.

When completed, the 22,600 acre-feet of water stored in Red Fleet Reservoir will be used for irrigating farms in the Vernal area and to supply the growing municipal and industrial needs of Vernal. Fishing and other water recreation activities will benefit the Ashley Valley community.

completed from the Twin Creek limestone and Nugget sandstone. The well's initial potential is second only to Quasar's 3-3 UPRR, nw se 3-2n-7e, a half mile to the northwest. That well was completed dually from Twin Creek and Nugget for a combined 4752 bbls of oil and 5,800,000 cu ft of gas daily.

Moon Lake

(continued from page 2)

of having been strongly disturbed. Rocks are displaced and the soil appears shaken and pulverized. Cracks run through clumps of sagebrush and the roots appear to have been torn apart. One large mountain mahogany bush also has roots extensively disturbed across a large crack.

The cracking probably does not represent the trace of the fault which caused the earthquake but is the main scarp of a large landslide triggered by the earth tremors. The slide appears to involve a large part of the alluvial fan moving downward into the valley of Lake Fork about 200 feet (60 meters) below.

The epicenter of the quakes has been recalculated and is now located about 1.5 miles (2.4 kilometers) southwest of Twin Pots Reservoir and about 3.0 miles south-southwest of the area of ground cracking.

The ground cracks were called to the Survey's attention by Mr. Brent Brotherson, science teacher at Altamont High School. Mr. George Fisher and others of his family showed the location of the cracking to Survey geologists and also pointed out rock falls in the vicinity of the ranch. This citizen cooperation is very much appreciated.

PINEVIEW - 17 SUCCESSFUL WELLS

American Quasar Petroleum has completed 3-6 UPRR, se se 3-2n-7e, in Summit County, Utah's Pineview field, flowing at a combined rate of 3712 bbls of oil and 3,351,000 cu ft of gas per day from Twin Creek and Nugget.

The new producer is on the southeastern edge of Pineview field and is the 17th consecutive successful well in the field. It is the seventh to have been dually

ROCKY RIDGES

by Greg McLaughlin





PROGRAM BUDGETING

This is the first year that our UGMS budget has reached one million dollars. In response to Governor Matheson's plans for Program Budgeting we are redefining our work in the light of the major goals that the UGMS seeks to fulfill. The great capacity of electronic accounting equipment will enable us to identify inefficiencies in our operation and take corrective steps. In the future we will be able to build our budgets upon individual project requirements rather than lump sum estimates.

URBAN AND ENGINEERING GEOLOGY SECTION:

Bruce Kaliser, Chief

Two geologists have joined the UGMS staff to assist Bruce Kaliser with studies relating to hillside development, earthquake hazard reduction, culinary water source protection, and groundwater supplies.

Benjamin Everitt, geomorphologist, comes from Tucson, Arizona. He completed his dissertation at Johns Hopkins University on a survey of desert vegetation of the north Henry Mountain region.

Ben is now working with the Seismic Risk Zone Mapping Program assigned to UGMS by the 1977 Legislative Session.

Bob Klauk, engineering geologist, is from Wisconsin. His thesis at the University of Wisconsin at Milwaukee is on the stratigraphy and engineering geology of the Pleistocene lake shores of Lake Michigan. Bob is now making a compilation of all Utah State political subdivision land development ordinances having geologic implications, in order to provide continued guidance for new ordinances for hillside development in the state. He is also assisting Section Chief Bruce Kaliser with a study of karst features in the Wendover area, requested by Tooele County, the State Division of Parks and Recreation, and the town of Wendover.

ENVIRONMENTAL SECTION,

Fitzhugh Davis, Chief

The second annual methane report to the U.S. Bureau of Mines is now on open-file at the UGMS. During the second year of the project, 22 coal, roof, and floor samples were obtained and tested for gas emission. Also, a four-month mapping project was completed in the Sunnyside No. 1 and No. 3 coal mines.

UGMS has recently compiled a bibliography of coal in Utah, now on open-file. The bibliography lists all available publications and theses to the end of 1976, with a few listed for 1977.

RESEARCH SECTION,

Wally Gwynn, Chief

Geothermal project: Geothermal energy as an alternative to fossil fuels is being studied in Utah. The most obvious geothermal resources are hot springs, such as Roosevelt Hot Springs, that have the potential for producing electricity. Less obvious are moderate temperature springs and ground water, widely distributed through out the state. UGMS is studying the moderate temperature resources of the state under a two-year contract with the U.S. Department of Energy. The objective is to locate and find new ways to use these geothermal resources..

In phase 1, all existing data related to the intermediate temperature geothermal resources of the state are to be compiled. Dr. Hank Goode, consultant with the Research section of the UGMS, will complete a preliminary geothermal data map and accompanying report summarizing all data available through mid-1978.

The second phase will be to expand the geothermal data base and to investigate all sites with potential for reservoir development. The research section staff is presently investigating sites at Crystal hot springs, near Draper; the Midway hot springs in the Heber Valley, and an area near Great Salt Lake Mineral corporation west of Ogden. Additional sites will be selected for study as the investigation continues.

At Crystal and Midway hot springs, 250-foot holes will be drilled in January and February to measure the geothermal gradients in the vicinity of the springs, and to study the characteristics and extent of the geothermal systems..

The ultimate goal of this investigation is to provide a report of detailed information of use to those interested in developing the geothermal resources. The report is scheduled to be available in late 1979.

PETROLEUM SECTION,

Jock Campbell, Chief

The Petroleum Section is currently involved in an ongoing study and evaluation of the state's extensive oil-impregnated rock deposits. A report dealing with the state's carbon dioxide occurrences and resources is nearing completion. The Petroleum Section is also studying several small oil fields in the Paradox Basin and in central Utah which will be incorporated in a larger study of petroleum accumulations of the Four Corners area to be published by the Four Corners Geological Society, Durango, Colorado. Other recent activities have included the review of the petroleum potential of lands subject to withdrawal by the Federal Government and the review of areas where certain types of industrial development might conflict with petroleum exploration and development.

Six Wildcats Staked in Great Salt Lake

Amoco Production has staked a half dozen offshore wildcats in an exploratory drilling program planned in Utah's Great Salt Lake, two in the northeastern part of the lake and four in its southern portion. Projected well depths range from 3500 to 11,000 feet, four to 13 miles off-shore. The first to be drilled will be 1 State-D, SE SW 23-8n-8w, a scheduled 3500 foot test in Box Elder County, in the northern part of the lake. It is about four miles southwest of the shut in Rozel Point field, which has produced heavy oil from shallow Tertiary. Drilling is scheduled to begin in mid-May 1978 from a rig mounted on an anchored barge. Cost of the first exploratory well is estimated at \$5 million, but subsequent wells are not expected to be so costly.

The drilling program started to take shape in the early 1970s. An extensive geophysical program was conducted late in 1973 and in 1974. Permits for two exploratory wells on the southern end of the lake were granted late in 1974, but because of economic conditions at the time, drilling was deferred. These locations were in 25 to 30 feet of water and four to five miles offshore (PI 10-23-74). Currently Amoco is working on the logistics of a marine drilling program and is seeking a contractor. The company will have two weather stations on the lake to measure wind and wave action.

From Petroleum Information Corp., Denver

FROM THE MOUTHS OF BABES

The UGMS Information and Sales department receives many letters of inquiry from educational institutions, government, organizations, energy companies, and mineral industry people. Orders placed for UGMS maps and publications are mailed the same day the letter is received.

We also receive letters from children from all parts of the country. Most are requesting a mineral specimen from Utah or a "rock" from the state. We usually send some sort of a sample with hopes that it will be in line with their wishes. Other requests aren't so easy to fill or answer. Here are a few of our latest letters:

Dear Sir:

I would like to know more about Natural Resources, for instance why we have Natural Resources, and what they are used for. And if there is any way we could have more? Thank you for reading my note.

Good Yours truly,
Anita H
Fort Wayne, Indiana

To Whom This May Concern:

We are doing state projects at school and, I have chozen Utah because I think it would be interesting to fine out more about minerals in Utah. Thank you for your time.

Your truly
Helen G.
Rice, Washington

Dear Sirs:

I am in the sixth grade at UMS Preparitory School. This year we have been studying all kinds of neat things like earthquakes. I would apriciate it greatly.

Thank you
Jim G.
Mobile, Alabama

Dear Sirs:

I have heard so much of your survey, I am in the sixth grade at UMS preperatory school. But if all possible I wonder if you could send me some information on rocks and rock samples. I know you have a hard job but if you could I'd love it. Thank you so much.

John A
?????

Dear Ladys and Gentlemen:

My class is studying Salt Lake City and would like to no a little about your city and surrounding citys. We would also like to no what you do.

Thank you,
Stacey T
Colorado Springs, Colorado

Dear Sirs:

I'm interest in rocks and minerals. Please send all the specimens that are available.

Thank you,
Mickey F
Peidmont, California

Dear Sir:

Both my brother and I have both wrote to you asking for free rock and mineral samples. We were both amazed with your quick response and lovely rocks you sent us. Your organization must be well organized and funded. Thanks again. No reply is needed.

Sincerely,
Erik and Walter S
Houston, Texas

Cause of Cedar City Subsidence Identified

Ground surface subsidence which has severely damaged a dozen or more single family dwellings and other structures in Cedar City was extensively investigated during 1977 by the Urban and Engineering Geology Section of UGMS. Aided by the Department of Transportation, five exploratory holes were drilled and seismic work conducted along two long traverses across the impacted area. Extensive ground observation and interviewing of long time residents revealed that problems of this sort have occurred since at least 1915. Many older buildings have been severely effected.

Nine months of study, analysis and consideration have led to the conclusion that the cause of the subsidence is "hydrocompaction" or densification of the soil mass upon application of water on the surface or in the shallow subsurface environment. Occurence of susceptible soils appears to be more widespread than the area investigated along Highland Drive, in the Highland Park Subdivision.

UGMS will continue to study the phenomena and render counsel and assistance wherever possible. Damage to date is estimated to be between \$650,000 and \$675,000 based on county tax assessment data.

HILLSIDE TERRAIN

(continued from page 1)

community, in developing and implementing its comprehensive city plan. The plan was based not only on considerations of environmental safety, but on aesthetic values as well. Founded on public surveys to determine the desires of the community, the plan has continued to receive the support of the community through the city council. It incorporates a hillside ordinance with population density control and seismic safety grading, erosion, and archeological preservation elements.

These topics were then discussed by a multidisciplinary panel in order to bring the "California experience" to bear on Utah problems. The panel included Merrill Ridd, geographer; Hooper Knowlton, civil engineer; Dell R. Cook, landscape architect; Henry Kesler, mortgage lender; Stanley Hollett, architect; and Michael Mazuran, attorney.

Mr. Hollett brought a historical perspective to the panel with his comments on the antiquity of hillside development, and suggested that recent problems are not "new" problems (since people have been living on hillsides for centuries), but are the result of a recent transfer of flat-land values, techniques, and scales to a new environment without adequate consideration of alternatives.

Attorney Michael Mazuran brought the group back to earth with a statement of the reality of the legal framework within which progress must take place.

Comments from the audience included the expression of concern by a developer over the adverse impact of government regulation of his activities.

UGMS OPEN FILE REPORTS

No. 20 Geology and Ore deposits of the San Rafael River mining area, Emery County, Utah, by Larry M. Trimble, 1976. Prepared in cooperation with the U.S. Geological Survey, Grant No. 14-08-0001-G-143.

No. 21 Iron Deposits of Utah, by Kenneth C. Bullock, 1976. Update of Bulletin 88.

No. 22 Lead and Zinc in Utah, by Lee I. Perry and Blair M. McCarthy, 1977. Prepared in cooperation with the U.S. Geological Survey, Grant No. GO264006.

No. 23 Methane Content of Utah Coals: First Annual Report to the U.S. Bureau of Mines, by Fitzhugh Davis and Hellmut Doelling, 1976 Grant No. GO166041

Notes from Mexico

Site of the world's most destructive earthquake of 1973 was inspected in December by Bruce N. Kaliser, UGMS chief engineering geologist. The Mexican temblor occurred on August 28, 1973 near the state line of Veracruz and Oaxaca (18.3° N., 96.6° W). More than 600 people were killed and thousands injured, with many more thousand left homeless. The quake was felt strongly at Mexico City. The 7.2 magnitude event, with its 84 km focus created intensity VII to VIII effects over about 1100 square kilometers of the states of Puebla and Veracruz. Rockfalls and landslides occurred in steep slopes in the epicentral area. Water level fluctuations were recorded in wells in Georgia, Idaho, Indiana, Nevada and Wisconsin.

Kaliser interviewed residents to ascertain extent of damage to numerous structures, particularly public facilities. He concentrated on the urban centers of Cordoba, Orizaba and Puebla. Worst damage seen was in the Orizaba suburb of Rio Blanco where the church had all but its walls collapse. Interestingly, a fine new labor union museum and office building has been built on the location where there was total destruction of a community of homes. It appears that the damage pattern was due to a combination of construction type and local geology. As is most frequently true during other

Latin American earthquakes, adobe homes were particularly affected. Fires were common, started by electrical short circuits. Near Tehuacan fifteen miners were killed in an onyx mine roof collapse.

On this same trip observations were made by Kaliser of coastal erosion at Veracruz and the geologic implications of ruins of past civilizations. At one of the pyramids at Zempoala, near the coast in the state of Veracruz, a recent shallow landslide made the site more interesting as it raised the question of how the remainder of the pyramid slope has so successfully withstood the test of time in such a humid climate. The pyramids at Zempoala are unique in that they are constructed entirely of well rounded field stones, rather than cut blocks of volcanic rock.

RESEARCH TOWER

(continued from page 1)

engineering data. The UGMS has received permission to place instrumentation on these towers, should we desire to do so and UGMS will have access to the data from the Amoco towers.

The real value of the research towers and the information they provide is that the data is obtained under actual lake conditions, which may be quite different from prevailing conditions at locations adjacent to, or miles from the lake. In addition, a variety of tests can be run from the stable platform, at a fixed location at any time during the year.

State of Utah—Department of Natural Resources
UTAH GEOLOGICAL AND MINERAL SURVEY
606 Black Hawk Way
Salt Lake City, Utah 84108

Address Correction Requested

Lake Bottoms Out

The level of Great Salt Lake reached its annual low on December 1, 1977 and began a slow rise. Gage heights recorded by the U.S. Geological Survey are:

Date	Boat harbor (south arm)	Saline (north arm)
November 1	4198.75	4197.85
November 15	4198.65	4197.80
December 1	4198.60	4197.80
Dec. 15, 1977	4198.70	4197.80
Jan. 1, 1978	4198.80	4197.85
Jan. 15,	4198.85	4197.90

The level of the south arm on January 15, 1978 was 1.65 feet lower than on the same date in 1977 reflecting the severe drought of 1977.

UTAH GEOLOGICAL AND MINERAL SURVEY SURVEY NOTES

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